2014-10-22 day 40

chain rule; 3.6 implicit differentiation

7) $f(x) = (x^3+2x)^{37}$

$x \mapsto (x^3+2x) \mapsto (\ )^{37}$

(2ND) (1ST)

take the der. of $(\ )^{37}$

$f'(x) = 37(x^3+2x)^{36} \cdot \frac{d}{dx}(x^3+2x)$

$\frac{d}{dx}(x^{37}) = 37(x)^{36}$

$f'(x) = 37(x^3+2x)^{36}(3x^2+2)$

$f(x) = (x^3+2x)^{37}$

$f(u) = (u)^{37}$

$u(x) = x^3+2x$

$f'(x) = f'(u) \cdot u'(x)$

$= 37u^{36} \cdot (3x^2+2)$

$= 37(x^3+2x)^{36}(3x^2+2)$

2014-10-22 day 40

chain rule; 3.6 implicit differentiation

8) $f(x) = (3x^2+2x-1)^6$

$f(u) = u^6$

$u(x) = 3x^2+2x-1$

$f'(x) = f'(u) \cdot u'(x)$

$= 6u^5 \cdot (6x+2)$

$= 6(3x^2+2x-1)^5 \cdot (6x+2)$

$x \mapsto (3x^2+2x-1) \mapsto (\ )^6$

$f'(x) = 6(3x^2+2x-1)^5 \frac{d}{dx}(3x^2+2x-1)$

$= 6(3x^2+2x-1)^5 (6x+2)$

chain rule; 3.6 implicit differentiation

2014-10-22 day 40

9) $f(x) = \left(x^3 - \frac{7}{x}\right)^{-2}$

$x \mapsto \left(x^3 - \frac{7}{x}\right) \mapsto (\ )^{-2}$

$f'(x) = -2\left(x^3 - \frac{7}{x}\right)^{-3} \frac{d}{dx}\left(x^3 - \frac{7}{x}\right)$

$= -2\left(x^3 - \frac{7}{x}\right)^{-3}\left(3x^2 + \frac{7}{x^2}\right)$

Question? $\frac{d}{dx}\left(\frac{7}{x}\right) = \frac{d}{dx}(7x^{-1})$

$= -7x^{-2} = \frac{-7}{x^2}$

ORRR

$\frac{d}{dx}\left(\frac{7}{x}\right) = \frac{\frac{d}{dx}(7)\cdot x - 7\cdot\frac{d}{dx}(x)}{x^2}$

$= \frac{-7(1)}{x^2} = \frac{-7}{x^2}$

$f(x) = \left(x^3 - \frac{7}{x}\right)^{-2}$

$f(u) = u^{-2}$

$u(x) = x^3 - \frac{7}{x}$

$f'(x) = (-2u^{-3})\left(3x^2 + \frac{7}{x^2}\right)$

$= -2\left(x^3 - \frac{7}{x}\right)^{-3}\left(3x^2 + \frac{7}{x^2}\right)$

2014-10-22 day 40

chain rule; 3.6 implicit differentiation

10) $f(x) = \frac{1}{(x^5 - x+1)^9} = (x^5 - x+1)^{-9}$

$u^9 \quad 9u^8$

$u = x^5 - x + 1 \quad 5x^4 - 1$

$9(x^5 - x + 1)^8 (5x^4 - 1)$

$\frac{f'g - g'f}{g^2}$

$((x^5 - x + 1)^9)^2 = (x^5 - x + 1)^{18}$

$\frac{-9(x^5 - x + 1)^8 (5x^4 - 1)}{(x^5 - x + 1)^{18}} = \frac{-9(5x^4 - 1)}{(x^5 - x + 1)^{10}}$

2014-10-22 day 40

chain rule; 3.6 implicit differentiation

10) $f(x) = \frac{1}{(x^5 - x + 1)^9} = (x^5 - x + 1)^{-9}$

$x \mapsto (x^5 - x + 1) \mapsto (\ )^{-9}$

$f'(x) = -9(x^5 - x + 1)^{-10} \cdot \frac{d}{dx}(x^5 - x + 1)$

$= -9(x^5 - x + 1)^{-10}(5x^4 - 1)$

$= -9 \frac{1}{(x^5 - x + 1)^{10}}(5x^4 - 1)$

2014-10-22 day **40**

chain rule; 3.6 implicit differentiation

11) $f(x)=\dfrac{4}{(3x^2-2x+1)^3}=4(3x^2-2x+1)^{-3}$

$f'(x)=4\dfrac{d}{dx}\left[(3x^2-2x+1)^{-3}\right]$

$x\longmapsto 3x^2-2x+1\longmapsto (\ )^{-3}$

$4f'(x)=4\left[-3(3x^2-2x+1)^{-4}\dfrac{d}{dx}(3x^2-2x+1)\right]$

$=4\left[-3(3x^2-2x+1)^{-4}\cdot(6x-2)\right]$

$=-12(6x-2)(3x^2-2x+1)^{-4}$

$f(x)=4f(u)$

where $u=(3x^2-2x+1)$

$f'(x)=4f'(u)\cdot u'(x)$

$f(x)=\dfrac{4}{(3x^2-2x+1)^3}$

$f'(x)=\dfrac{\frac{d}{dx}(4)\cdot(3x^2-2x+1)^3-4\frac{d}{dx}(3x^2-2x+1)^3}{(3x^2-2x+1)^6}$

chain rule; 3.6 implicit differentiation

2014-10-22 day 40

13) $f(x) = \sqrt{4+\sqrt{3x}}$

$x \mapsto 3x \mapsto 4+(\ )^{1/2} \mapsto (\ \ )^{1/2}$

$f'(x) = \frac{1}{2}\left(4+\sqrt{3x}\right)^{-\frac{1}{2}} \cdot \frac{d}{dx}\left(4+\sqrt{3x}\right)$

$= \frac{1}{2}\left(4+\sqrt{3x}\right)^{-1/2} \cdot \left(0+\frac{1}{2}(3x)^{-\frac{1}{2}} \cdot \frac{d}{dx}(3x)\right)$

$= \frac{1}{2}\left(4+\sqrt{3x}\right)^{-\frac{1}{2}}\left(\frac{1}{2}(3x)^{-\frac{1}{2}}\right)(3)$

2014-10-22 day 40

chain rule; 3.6 implicit differentiation

$$f(x) = \sqrt{4+\sqrt{3x}}$$

$$f(x) = f(u) = \sqrt{u} = (u)^{1/2}$$

where $u(v) = 4+\sqrt{v}$

where $v=3x$

$f'(x) =$

$f'(u)\cdot u'(v)\cdot v'(x)$

$=$

$\frac{1}{2}u^{-\frac{1}{2}}\cdot\frac{1}{2}v^{-\frac{1}{2}}\cdot 3$

2014-10-22 day **40**

chain rule; 3.6 implicit differentiation

3.5/14 $f(x)=\sin^3 x = (\sin x)^3$

$= 3\text{power}(\sin x)$

$x \mapsto \sin x \mapsto (\ )^3$

$f'(x) = 3(\sin x)^2 \cdot \frac{d}{dx}(\sin x)$

$= 3(\sin x)^2 \cdot (\cos x)$

2014-10-22 day 40

chain rule; 3.6 implicit differentiation

3.5/16) $f(x) = \cos^2(3\sqrt{x}) = (\cos(3\sqrt{x}))^2$

$x \mapsto 3\sqrt{x} \mapsto \cos(\ ) \mapsto (\ )^2$

$f'(x) = 2(\cos(3\sqrt{x}))\frac{d}{dx}(\cos(3\sqrt{x}))$

$\frac{d}{dx}(3x^{\frac{1}{2}}) = \frac{3}{2}x^{-\frac{1}{2}}$

$= 2(\cos(3\sqrt{x}))(-\sin(3\sqrt{x}))\cdot\frac{d}{dx}(3\sqrt{x})$

$= 2(\cos(3\sqrt{x}))(-\sin(3\sqrt{x}))\left(\frac{3}{2\sqrt{x}}\right)$